Think small when powering today's electronic soldier

On the battlefield, having a reliable source of power to operate the many advanced electronic devices a soldier carries is essential. But today's heavy and cumbersome batteries fall short of satisfying the military's needs. In search of both a lightweight and reliable alternative, the Department of Energy's Pacific Northwest National Laboratory has developed the smallest power system yet, all wrapped up in a micro-sized package.

PNNL researchers, with funding from the Defense Advanced Research Projects Agency, have developed the world's smallest catalytic fuel processing reactor system to provide a low-watt power source for hand-held wireless equipment, sensors and other small but essential devices required by today's troops.

The tiny power system — about the size of a cigarette lighter — converts liquid fuel to electricity via a microscale fuel processor coupled with a microscale fuel cell developed by Case Western Reserve University in Ohio. An integral part of the system is PNNL's revolutionary fuel reformer, about the size of a pencil eraser, which enables the system to convert fuel and water into hydrogen-rich gas. The fuel cell then generates electricity by converting hydrogen and oxygen from the air into electrical power and clean water.

"Our miniaturized fuel processor incorporates several chemical processes and operations in one device," said Evan Jones, PNNL principal investigator. The fuel processor system contains two vaporizers, a heat exchanger, a catalytic combustor and a steam reformer, all within a package no larger than a dime.

The military envisions many useful applications for this emerging miniaturized energy-generating technology. According to Terry Doherty, director of PNNL's Department of Defense programs, soldiers could power personal, lightweight cooling systems while wearing protective suits and gear, prolonging their comfort and efficiency during a reconnaissance.

Continued on page 5.

PNNL's revolutionary microscale fuel processor, which consolidates several chemical processes and operations into one package, is considered the world's smallest integrated catalytic fuel reformer.

Think small when powering today's electronic soldier, cont.

"Vital personal communications devices could function for extended periods without the added weight of bulky, inefficient batteries," Doherty said. He added that miniature sensors powered by the same technology could be scattered before advancing troops to monitor ground vibrations or detect dangerous toxic agents and relay this information electronically to soldiers. This technology broadens the possibilities for using self-sustaining items such as mobile devices in remote or difficult-to-access locations.

While methanol has proved to be the most effective fuel source, other liquid fuels such as butane, jet fuel or even diesel may be used. And, because the hydrogen power source is only produced as needed, there is no need to store or carry the volatile gas, reducing risk and creating a lighter load.

Testing has revealed that performance from the reformer and fuel-cell prototype is impressive. "This system can produce an equivalent power to batteries, but at one-third the weight," Jones said. Similar micro fuel-cell systems currently under development are providing power equal to that of batteries weighing 10 times as much. Researchers suggest that additional improvements could result in even greater performance. Development will now focus on creating a deployable system suitable for military use or industrial application. ■